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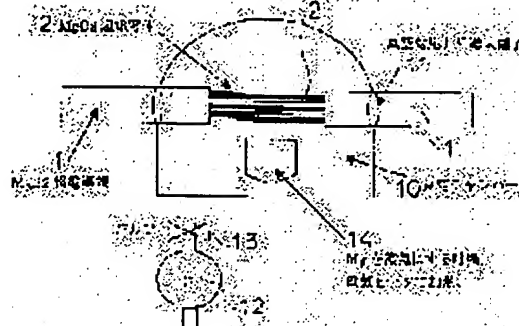
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(54) CONNECTION PART OF SUPERCONDUCTING LINE AND ITS CONNECTING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a connection part and its connecting method of the MgB₂ superconducting line which does not spoil the critical current.

SOLUTION: Exposing the connection part of the superconducting line 1 to make it as a MgB₂ superconductor 2, and making it locate in a vacuum chamber 10 through a vacuum corresponding lead introducing terminal 11, MgB₂ superconductors 2 are contacted mutually. By exposing the portion, where these MgB₂ superconductors 2 themselves have been contacted, in Mg-vapor atmosphere of about 900°C, the MgB₂ superconductor is formed in the contact portion. After that, taking it out from the vacuum chamber 10, putting the connection portion of these superconductors 2 into a small copper cup, and pouring lead-tin solder in it, makes the connection portion of the MgB₂ superconductors fix. When connection resistance of the MgB₂ superconducting line containing this connection portion is measured, it is 1 nΩ or less, which is considered to be superconductivity



connection. Moreover, by the measurement of the critical current containing the connection portion, it shows the same value with the critical current of at the time of a MgB₂ superconducting-line simple substance, that is, fall of the superconductivity characteristic is not seen, either.

LEGAL STATUS

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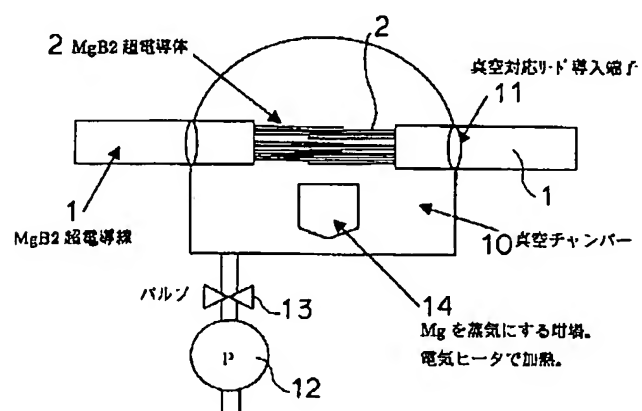
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Drawing selection Representative drawing ☒

[Translation done.]

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Notes:

1. Untranslatable words are replaced with asterisks (****).
2. Texts in the figures are not translated and shown as it is.

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Dictionary: Last updated 03/03/2006 / Priority: 1. Chemistry / 2. Natural sciences / 3. Manufacturing/Quality

CLAIMS

[Claim(s)]

[Claim 1] MgB₂ In the terminal area of superconducting wires, it is MgB₂. MgB₂ characterized by contacting superconductors and heat-treating in Mg steam Terminal area of a superconducting wire.

[Claim 2] MgB₂ In the terminal area of superconducting wires, it is MgB₂. MgB₂ characterized by contacting superconductors, twisting boron foil around the portion, and heat-treating in Mg steam Terminal area of a superconducting wire.

[Claim 3] MgB₂ Superconductors are contacted and it is MgB₂ to a contact portion. MgB₂ according to claim 1 or 2 characterized by applying fine particles Terminal area of a superconducting wire.

[Claim 4] MgB₂ In the connection method of superconducting wires, it is MgB₂. MgB₂ of a superconducting wire Superconductors are contacted. It heat-treats by being exposed into Mg steamy atmosphere, and is MgB₂ to a contact portion. MgB₂ characterized by making a superconductor form and fixing a terminal area with **** pewter Connection method of a superconducting wire.

[Claim 5] MgB₂ In the connection method of superconducting wires, it is MgB₂. MgB₂ of a superconducting wire Contact superconductors and boron foil is twisted around a contact portion. It heat-treats by being exposed into Mg steamy atmosphere, and is MgB₂ to a contact portion. MgB₂ characterized by making a superconductor form Connection method of a superconducting wire.

[Claim 6] MgB₂ It is MgB₂ to the contact portion of a superconductor. MgB₂ according to claim 4 or 5 characterized by applying fine particles Connection method of a superconducting wire.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention is MgB₂. It is related with the terminal area (joint) of superconducting wires, and its connection method.

[0002]

[Description of the Prior Art] Generally [connection of superconducting wires, such as a metal system low-temperature superconducting wire, Bi system metal sheath oxide system high-temperature superconductivity line (oxide superconductivity line), and Y system oxide superconductivity line,] As shown in drawing 4 , an energization electric current value and a connection resistance value connect superconducting wire 21 comrades with the soldering 22 as it is, it was the length of the soldering field 22 and this changed. As it is considered as the method of making connection (joint) resistance of a superconducting wire low and connection of a metal system low-temperature superconducting wire shows to drawing 5 Dissolve the stabilization metal of the superconducting wire 21 and the superconductor (filament) 23 is exposed. The method of connecting the superconductors which performed coppering to the method of connecting the superconductor 23 comrades with the soldering 22 and a certain exposed superconductor 23 from which it crawled and the stabilization metal was removed, and performed the coppering with the soldering 22 is known. Moreover, as connection of an oxide system metal sheath superconducting wire shows to drawing 6 , filament 25 comrades of oxides superconductors which exfoliated and exposed some sheaths of the oxide system metal sheath superconducting wire 24 are contacted. The heat treatment method of making the oxide superconductivity filament 26 re-generating in oxygen environment is known.

[0003] By the way, MgB₂ A superconductor is Nb₃Sn. It is an intermetallic compound similarly and the superconductivity characteristics were discovered recently. This MgB₂ If in charge of connection of a superconductor, lead system pewter is MgB₂ in filaments. In order not to take a superconductor directly, after carrying out coppering to a filament, the method of soldering filaments is taken. Moreover, MgB₂ Filaments may be directly connected to a superconductor, using low-melting pewter (pewter containing Bi) as a method of bending coppering.

[0004]

[Problem to be solved by the invention] As mentioned above, MgB₂ although coppering is performed and soldered to a filament or connecting using low-melting pewter is performed in the superconductor Since MgB₂ superconductor was a compound, it had the problem that superconductivity characteristics (critical current) fell by distortion, the boron core wire which constitutes a filament further broke easily, and there was a problem that a filament fractured at the process at which filaments are contacted. When the fracture of such a filament occurs also partly, the cross-section area of a superconducting wire decreases and critical current is made to fall. Moreover, even when the fracture of a filament was able to protect, it was difficult for there to be a problem that critical current falls and to make healthy (for there to be no fall of

critical current) connection by distortion added to a filament.

[0005]

[Means for solving problem] This invention is for solving the above-mentioned technical problem, and is MgB₂. In the terminal area of superconducting wires, it is MgB₂. MgB₂ characterized by contacting superconductors and heat-treating in Mg steam It is the terminal area of a superconducting wire. Moreover, this invention is MgB₂. In the terminal area of superconducting wires, it is MgB₂. MgB₂ characterized by contacting superconductors, twisting boron foil around the portion, and heat-treating in Mg steam It is the terminal area of a superconducting wire. Moreover, above MgB₂ of this invention The terminal area of a superconducting wire is MgB₂. Superconductors are contacted and it is MgB₂ to a contact portion. It is characterized by applying fine particles.

[0006] Moreover, this invention is MgB₂. In the connection method of superconducting wires, it is MgB₂. MgB₂ of a superconducting wire Superconductors are contacted. It heat-treats by being exposed into Mg steamy atmosphere, and is MgB₂ to a contact portion. MgB₂ characterized by making a superconductor form and fixing a terminal area with **** pewter It is the connection method of a superconducting wire. Moreover, this invention is MgB₂. In the connection method of superconducting wires, it is MgB₂. MgB₂ of a superconducting wire Contact superconductors and boron foil is twisted around a contact portion. It heat-treats by being exposed into Mg steamy atmosphere, and is MgB₂ to a contact portion. MgB₂ characterized by making a superconductor form It is the connection method of a superconducting wire. Furthermore, above MgB₂ of this invention The connection method of a superconducting wire is MgB₂. It is MgB₂ to the contact portion of a superconductor. It is characterized by applying fine particles.

[0007]

[Function] This invention is MgB₂. MgB₂ of a superconducting wire by contacting superconductors and heat-treating in Mg steam Even when distortion is added or a fracture arises in part in the connection, it is MgB₂ of a connection part. since recover the fall of the superconductivity characteristics by distortion of a superconductor, a fracture part is re-generated or an electric bypass circuit is newly formed Connection which does not spoil critical current can be made.

[0008]

[The form of the actual condition of invention] MgB₂ in this invention The terminal area of the superconducting wire by which pre-insulation is carried out is exposed, and connection of superconducting wires is MgB₂. It is considered as a superconductor and is MgB₂. Superconductors are contacted, and it heat-treats in Mg steamy atmosphere, and is MgB₂ to a contact portion. A superconductor is formed. MgB₂ As a superconductor, it is MgB₂, for example to the surface of a boron line. It is MgB₂ in the thing which twisted the generated

superconductive element line, and some substances. Connection can also be made although contained.

[0009]

[An example 1] The example 1 of this invention is explained with reference to Table 1, drawing 1, and drawing 2. Drawing 1 is MgB₂. It is the vacuum chamber 10 which carries out like the jointer of a superconducting wire, and it has the lead introduction terminal 11 corresponding to a vacuum, a pump 12, and a valve 13, and the crucible 14 which makes Mg a steam is formed. Drawing 2 is MgB₂ after taking out from Mg steamy atmosphere. The connection (joint) portion of a superconductor is fixed and **** pewter 17 is slushed into the copper small cup 16. Table 1 is MgB₂ which connects an example 1. It is a superconductor and is MgB₂ to the boron line $\phi 0.2\text{mm}$ surface. What twisted the generated superconductive element line is used. In addition, under the liquid helium temperature 4.2K and a self-magnetic field, flow, and the column of a superconducting wire 10A Twists 7x7x7 columns of the critical current of Table 1, and [doubling] Seven wires twist, it is 7 more doubling structures with twist and the thing twisted further combining them seven in the things twisted seven, and the number of sum total wires is 343.

[Table 1]

MgB ₂ 超電導体の諸元	
超電導素線:	ボロン線 $\phi 0.2\text{mm}$ の表面に MgB ₂ を生成した素線。
臨界電流:	10A (4.2K, 自己磁界)
超電導線:	超電導素線の 7x7x7 本撚り合わせ。
絶縁被覆:	ガラス編組厚さ 70 μm 。

[0010] Covering of the connection schedule portion of the superconducting wire 1 with which the glass braid of Table 1 (pre-insulation) was carried out is removed, and it is MgB₂. The superconductor 2 is exposed. It fixes through the lead introduction terminal 11 corresponding to a vacuum, and this is located in the vacuum chamber 10, as shown in drawing 1, and it is MgB₂. Superconductor 2 comrades are contacted. This MgB₂ The portion into which superconductor 2 comrades were contacted is exposed into about 900-degree C Mg steamy atmosphere, and it is MgB₂ to a contact portion. The superconductor was formed. Within the chamber 10 made into the vacuum, Mg steamy atmosphere heated crucible 14 by the electric heater, evaporated Mg, and was formed.

[0011] Then, as it takes out from the vacuum chamber 10 and is shown in drawing 2, it is MgB₂ of the superconducting wire 1. After putting a part for the terminal area 3 of superconductor 2 comrades into the copper small cup 16, **** pewter 17 is slushed, and it is MgB₂. The connection (joint) portion 3 of the superconductor was fixed. MgB₂ containing a part for this terminal area 3 The superconductor 2 is cooled in liquid helium. Measurement of the critical current which connection is less than 1nohm considered to be superconductivity

connection, and contains a part for a terminal area when connection resistance is measured is also MgB₂. The same value as the critical current at the time of a superconducting wire simple substance was shown, and the fall of superconductivity characteristics was not seen. MgB₂ same for comparison on the other hand although the connection resistance itself is about 100n Ω respectively in what was connected by the coppering using a line, and the thing connected with low-melting pewter. In the critical current measurement having contained a part for a terminal area, it is 60% to about 70% at the time of a simple substance, and is MgB₂ of an example 1. What superconductors were contacted, heat-treated in Mg steam, slushed **** pewter, and fixed the connection (joint) portion was what shows outstanding characteristics. [0012] Moreover, the terminal area of the superconducting wire 1 by which the glass braid (pre-insulation) was carried out is exposed, and it is MgB₂. It is considered as the superconductor 2 and is MgB₂ to this connection (joint) portion 3. Fine particles were applied, and as shown in drawing 1, ** stylish connection was made in about 900-degree C Mg steamy atmosphere. Above MgB₂ when there is no fall of superconductivity characteristics at this connection method. The connection resistance value became half and the case of the connection method which does not apply fine particles was excelled as superconductivity connection. In addition, MgB₂ shown in Table 1 in the example 1. Although the superconductor was used, about form, a size, etc., except this is sufficient and it is MgB₂ in some substances. The superconductivity connection which was excellent with such connection is obtained that what is necessary is to just be contained.

[0013]

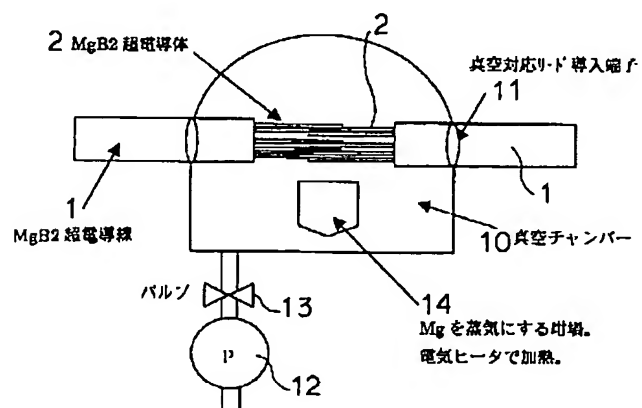
[An example 2] An example 2 is the heat treatment method of boron foil attachment, and is explained with reference to Table 1, drawing 1, and drawing 3. As shown in drawing 3, the terminal area of the superconducting wire 1 with which the glass braid of Table 1 (pre-insulation) was carried out is exposed, and it is MgB₂. It is considered as the superconductor 2 and is MgB₂. Superconductor 2 comrades are contacted. MgB₂ Into the portion into which superconductor 2 comrades were contacted, the 0.03-mm-thick boron foil (30mm by 50mm) 4 is twisted and covered. In addition, the thickness and the size of boron foil change according to the size for a terminal area, or other situations. This MgB₂ The portion which twisted and covered the boron foil 4 is located in the vacuum chamber 10, as shown in drawing 1, and it is exposed [superconductor 2 comrades are contacted,] into about 900-degree C Mg steamy atmosphere, and it is MgB₂ to the contact portion 3. The superconductor was formed. MgB₂ containing a part for this terminal area. A superconductor is cooled in liquid helium. Measurement of the critical current which connection is less than 1n Ω considered to be superconductivity connection, and contains a part for a terminal area when connection resistance is measured is also MgB₂. The same value as the critical current at the time of a superconducting wire simple substance was shown, and the fall of superconductivity

characteristics was not seen.

[0014]

[Effect of the Invention] According to this invention, it is MgB₂ as explained above. MgB₂ of a superconducting wire by contacting superconductors and heat-treating in Mg steam Even when distortion joins the terminal area or a fracture arises in part, it is MgB₂ of a connection part. since recover the fall of the superconductivity characteristics by distortion of a superconductor, a fracture part is re-generated or an electric bypass circuit is newly formed The effect that connection which does not spoil critical current can be made is done so.

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[Report Mistranslation](#)

[Japanese \(whole document in PDF\)](#)

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